

# OzDES Proposal to join the Supernova Working Group of the Dark Energy Survey as a Broad-Scope External Collaboration

20<sup>th</sup> January 2013

Version 1

## I. Introduction

This document outlines a proposal from Professor Bob Nichol (sponsoring DES participant) of the Institute of Cosmology and Gravitation at the University of Portsmouth and Chris Lidman of the Australian Astronomical Observatory (AAO). We request a Broad-Scope External Collaboration<sup>1</sup> (EC) between members of the OzDES collaboration (see below) and members of the Dark Energy Survey (DES) supernova science working group (SNSWG). The aim of this document is to describe the unique contribution that members of the OzDES collaboration can make to DES.

## II. The OzDES collaboration

The OzDES collaboration is a team of Australian researchers who wish to contribute to and participate in projects related to the SNSWG. Led and managed by Karl Glazebrook (Swinburne University), the membership of OzDES currently consists of Chris Blake (Swinburne University), Jeremy Mould (Swinburne University), Greg Poole (University of Melbourne), Matthew Colless,

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<sup>1</sup> See <https://cdcvns.fnal.gov/redmine/projects/des/wiki/DESpolicies> for the including the definition of a broad-scope EC request

Brian Schmidt and Rob Sharp (Australian National University), Tamara Davis (University of Queensland) and Chris Lidman (Australian Astronomical Observatory). OzDES team members have extensive experience in operating wide-field multi-object spectrographs, such as 2dF+AAOmega on the AAT, and are active researchers in the fields of galaxy evolution, cosmology and supernovae.

The OzDES collaboration currently includes one graduate student, Syed Ashraf Uddin, who is jointly supervised by Karl Glazebrook, Jeremy Mould and Chris Lidman.

### III. Context and Rationale

When combined with constraints from external datasets, the four probes of DES will constrain the dark energy-of-state parameter to a level of accuracy that is equivalent to or better than a stage III experiment, as defined in the Dark Energy Task Force report. Current data are consistent with Einstein's Cosmological Constant, in which the dark energy equation-of-state parameter is exactly -1. Finding a value that differs from -1 would be as revolutionary as the discovery of the accelerating Universe itself. As the most established method and the one that currently contributes most to constraining dark energy, the constraints provided by Type Ia supernovae (SNe Ia) are crucial.

DES will discover around 4000 SNe Ia with high quality light curves (Bernstein et al. 2012). Unlike earlier surveys, such as the Supernova Legacy Survey and Sloan Digital Sky Survey II, real-time spectroscopy for all 4000 SNe Ia discovered by DES, which is used to confirm all SNe Ia and to estimate their redshifts, will not be feasible. Instead, SN typing will need to be determined photometrically, and redshifts for the majority of SN candidates will need to be obtained from spectroscopy of the SN host galaxy. Such a new technique has already been shown to work well for both SNLS [1] and SDSS-II [2]. Currently, photometric redshifts from the host or the SN itself are neither sufficiently precise nor sufficiently unbiased.

The optimal telescope and instrument for such SN host galaxy spectroscopy is the AAOmega fiber-fed spectrograph on the Australian Astronomical Telescope (AAT). This combination has

sufficient fibers and aperture to efficiently target hundreds of host galaxies of DES transient events, leading to a unique multiplexing that is not available anywhere in the world. AAOmega+AAT will need to be the “work horse” for DES SN spectroscopic follow-up over the five years of DES and this proposal will be essential for making this happen.

The OzDES team has extensive experience in using 2dF+AAOmega, a wide-field multi-object fiber positioner and spectrograph on the AAT. Using the fields of the Supernova Legacy Survey as a test case, OzDES has already demonstrated that it can use 2dF+AAOmega to obtain hundreds of host galaxy redshifts over the exact redshift (and magnitude) range probed by the DES SN sample [1].

As a first step, OzDES has already obtained 4 nights of AAT time in December 2012 to target the DES SN. This pilot run was successful confirming the potential of AAOmega in following-up active SNe as well as faint stars and galaxies. (see the attached article on these observations for the “AAO Newsletter”).

From this experience, and the experience gained in targeting the fields of the Supernova Legacy Survey [1], we estimate that, with only 40 nights on the AAT, we can obtain redshifts for 60% of all SNe Ia discovered by DES and we intend to apply for this minimum amount of time under the framework of this agreement. There are compelling scientific reasons to expand this request to over 100 nights when including non-SN cases and targets, and we will develop this plan in collaboration with DES members

#### IV. Principles of the Collaboration

The two collaborations (OzDES and DES) agree on the following principles:

1. OzDES will manage the entire process of collecting data from the AAT. This includes applying for telescope time, obtaining and processing the data, and making the data available to the DES collaboration. OzDES will provide the raw data, the wavelength-calibrated sky-subtracted spectra, redshifts and their associated errors, and an estimate of the reliability of the redshift. The data will be available to any member of the DES collaboration (not just

members of the DES SNSWG) at the same time as it becomes available to OzDES members (including raw data if requested). There is no proprietary period between OzDES and DES.

2. DES will provide OzDES with the data necessary to prepare for the AAT follow-up. This includes astrometrically correct images of the DES SN fields and target catalogues containing coordinates and priorities. DES and OzDES will set target priorities by mutual agreement.

3. As outlined in the attached AAO Newsletter article ‘Spare fibres’ (meaning those not targeting active SNe or SN hosts which could be the majority of fibres at the beginning of DES) will be allocated to targets (e.g. photo-z calibration, brightest cluster galaxies, AGN, weak lensing/velocity correlations) again by mutual agreement between OzDES and DES members. It is expected that OzDES members will play a key role in defining and leading the AAT spare fibres science, in collaboration with DES scientists; we will provide a specific plan after evaluating the 2012B pilot data in early 2013 for formal approval by the DES management as an addendum to this MOU.

4. Joining the SNSWG as external collaborators does not exclude members of OzDES from applying to become full members of the DES collaboration at a future date i.e. members of other WGs) at a future date but this may require an additional proposal and/or EC request.

5. For each member of the OzDES collaboration there will not be more than one post-doc or student working on data from DES at any given time. These students and postdocs will be named by the OzDES team leads (Glazebrook & Lidman) and approved by the SNSWG co-chairs. Both parties will maintain a list of active students and postdocs working with OzDES members.

6. All OzDES members (including approved students and postdocs) will be actively encouraged to participate in the regular DES SNSWG meetings, including the regular collaboration meetings and regular phone conferences. The expense in participating in such meetings will be covered by OzDES members.

7. OzDES members will work in collaboration with DES members on a broad range of science topics as envisaged by such a Broad-Scope EC application. All joint projects will be announced to the DES SNSWG and will remain open for participation to all DES SNSWG and OzDES members. Joint projects can include DES data beyond the simple overlap between the DES and OzDES data e.g. constraining cosmological parameters from all DES-detected SNe Ia, not exclusively SNe Ia with AAT spectroscopy. Other example projects include estimating biases that come from a sample of a photometrically selected sample of SNe Ia that have host galaxy redshifts, and cosmology from supernova subsamples (e.g. SNe Ia in early type galaxies). This requires access to DES images and/or catalogues of the host galaxies for the purpose of computing star formation rates from the photometry and access to lightcurve parameters.

8. This agreement does not exclude the possibility of OzDES team members working on projects that are outside of the scope of the SNSWG. Such joint efforts are not covered in this agreement but will be covered through a standard EC application between OzDES team members and the relevant DES working group. This item will be reviewed if and when team members of OzDES become full members of DES.

9. All DES publications that use spectroscopic data from OzDES must be sent to OzDES members for comment and approval and will have OzDES members as authors if they request this. This covers all projects started using proprietary OzDES and DES data (i.e. not public). Projects started using public OzDES and DES data are not covered by this agreement, but we encourage such work to still be communicated to OzDES and DES SNSWG teams.

10. New OzDES members need to be first approved by the OzDES management and then forwarded to DES for approval following normal EC procedure outlined in “Procedures for Adding External Collaborators”.

11. Members of OzDES agree to abide by the Membership and Publication Policies of DES and the Principles for the Organisation and Management of DES Science Projects.

12. The duration of this collaboration between DES and OzDES is three years from the date of its approval, and covers the DR1 data collected during this period even if it is released to the public during this time. We will annually review the progress of the collaboration, in line with DES procedures (see “Procedures for Adding External Collaborators”). The duration of collaboration can be extended in time and to cover future data releases if both OzDES and DES agree to an extension.

13. The EC arrangement outlined herein does not extend to, or exclude, OzDES members applying for time on other telescope facilities to supplement the original data taken at the AAT i.e., further follow-up of interesting spectra and /or additional observations of a complementary set of sources. We would hope, and expect, such additional observations to be done in collaboration with DES SNSWG members but it is not required.

14. The title of this collaboration will be: OzDES spectroscopic follow-up of the DES SN fields.

15. The OzDES members will continue to negotiate, separately, full membership of DES conditional on the award of a significant amount of AAT time (i.e. in the range 80–200 nights<sup>2</sup>) as an in-kind contribution to DES and addressing a more ambitious set of joint science goals that are currently being developed. If this is successful then that will replace this agreement.

[1] Lidman, C. et al. 2012, PASA (in press) arXiv:1205.1306

[2] Campbell, H et al. 2012, ApJ, arXiv:1211.4480

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<sup>2</sup> We note each AAT night is officially valued at AUD 12,000 (1 AUD = 1.05 USD) so 80 nights would be a \$1.0M in-kind contribution.